

## **CANYONLANDS NATIONAL PARK RESEARCH SUMMARY 2007**

**1) Study Title:** Incision and exhumation history of the Colorado Plateau in the Canyonlands to Book Cliffs Region, Utah

**Permit No.: CANY-2007-SCI-0001**

**Principal Investigator:** Markella Hoffman

**Purpose of Scientific Study:** This study will investigate the temporal and spatial distribution, magnitude, and rate of erosional exhumation and river incision of the central Colorado Plateau. Low-temperature thermochronology will establish the thermal history of east-central Utah, between the Colorado and Green Rivers and the Book and Roan Cliffs, in response to stream down cutting, catchment-wide erosion, and laterally and vertically driven cliff retreat. Apatite (U-Th)/He thermochronometric studies of subsurface cores and surface samples can be used to quantify the thermal and erosion history, reconstruct of the geomorphic evolution of this spectacular landscape (<10 Ma), and test new isostatic flexural uplift models that make specific predictions about erosional exhumation within the core of the Colorado Plateau.

**Findings/Accomplishments for 2007:** My research is using apatite (U-Th)/He thermochronometry to quantify the erosional history in the Book Cliffs to Canyonlands regions of east-central Utah. Fieldwork was conducted in May, 2007. Sandstone rock samples were collected for thermochronometric analyses in the Book Cliffs, along roads just north of Canyonlands, and along Shafer Road and White Rim Road in Canyonlands National Park.

In Canyonlands National Park, 10 samples were collected approximately every 100 m of elevation change along Shafer Road. These samples are expected to quantify the timing of incision of the Colorado River. We planned to collect more samples along White Rim Road and also collect in Lathrop Canyon, however car problems prevented us from driving further into Canyonlands. Analytical work on these Canyonlands samples is in progress. Some samples are undergoing mineral separation to extract apatite. Others are being analyzed in the Isotope Geochemistry Lab of the University of Kansas. A few preliminary cooling ages have been determined, but more are needed in order to more comprehensively deduce a cooling history in response to incision of the Colorado River.

In the Book Cliffs, samples collected along three vertical transects (Hay Canyon, Sego Canyon, and Blaze Canyon) are expected to record cooling in response to vertical and lateral erosion associated with escarpment retreat. These samples have not been processed yet.

More analytical work is required to determine the timing, magnitude, and spatial distribution of erosional exhumation along the central Colorado Plateau. It is possible more sampling from Canyonlands National Park will be necessary. New thermochronometric data and numerical modeling will enable us to not only elucidate the erosional history, but also test geomorphic and geodynamic models making predictions about the timing and spatial magnitude of erosional exhumation in the center of the Colorado Plateau

**2) Study Title:** Assessment of Upland Ecosystem Conditions in the Salt Creek Watershed, Canyonlands National Park

**Permit No.: CANY-2007-SCI-0002**

**Principal Investigator:** Mark Miller

**Purpose of Scientific Study:** The purpose of this project is to assess the condition of upland ecosystems in the Salt Creek watershed and surrounding portions of Canyonlands National Park (CNP) using a suite of quantitative and qualitative

indicators related to the functioning of key ecosystem processes. Salt Creek is the only perennial stream in CNP other than the Colorado River itself, and riparian and aquatic ecosystems associated with the Salt Creek drainage may be affected by upland watershed conditions impacted by past land-use practices (e.g., livestock grazing), recent / current visitor-use activities, or on-going drought.

**Findings/Accomplishments for 2007:** During the 2006 field season, approximately 100 assessments were conducted in the lower, middle, and upper Salt Creek watersheds. In 2007, 50 assessments were conducted in lower, middle, and upper Salt Creek; as well as in Elephant Canyon, Butler Wash, Lavender Canyon, and Davis Canyon watersheds. Fewer assessments were conducted in 2007 than expected because road and weather conditions prevented access to some remote field locations. To complete data collection for high-priority ecosystems and watersheds, approximately 15 additional assessments will be conducted in FY2008 in conjunction with a companion project funded by The Nature Conservancy (TNC). This TNC project was initiated on Bureau of Land Management (BLM) lands adjacent to CNP in 2007, with 130 assessments conducted this year and 50-100 planned for 2008. Both projects use identical sampling strategies and field methods, and combined analysis of both data sets will greatly improve our capacity to understand patterns of ecosystem condition in relation to past and on-going land-use activities, climate, and soil properties. For example, preliminary analyses suggest that soil stability and ground cover both tend to be higher on NPS lands in CNP than on BLM lands. Emerging patterns also suggest that particular soils and types of ecosystems are highly susceptible to long-term dominance by invasive exotic plants. Results of this project will allow NPS staff to evaluate current conditions in relation to management objectives and "desired future conditions," as well as to establish priorities for restoration or other management actions. Data collected on NPS lands will help BLM managers better understand the condition of lands they manage, and data for both companion projects will be used by the NPS Inventory and Monitoring Program, the USDA Natural Resources Conservation Service, TNC, and USGS to better understand ranges of variability in indicators of ecosystem condition and to develop hypotheses concerning the resistance and resilience of particular soils / ecological sites to interactive effects of climate and land-use activities.

**3) Study Title:** Testing hypotheses for the origin of Upheaval Dome, Canyonlands National Park, Utah, using deformation bands

**Permit No.: CANY-2007-SCI-0003**

**Principal Investigator:** Chris Okubo

**Purpose of Scientific Study:** This proposal presents work that is a continuation of a previous NPS study (Study # CANY-00095, Permit # CANY-2005-SCI-0030, "Testing hypotheses for the origin of Upheaval Dome, Canyonlands National Park, Utah, using deformation bands."). This work focuses on quantifying geologic evidence that supports a meteoritic impact origin for Upheaval Dome. The previous study found that the style of faulting within the Wingate Sandstone is indicative of a meteoritic impact, and supports a post-Early Jurassic age for this impact. This work is currently under review for publication in the journal Earth and Planetary Science Letters. The work proposed here builds upon these previous results and will quantify the distribution and microstructure of cataclastic dikes of Wingate Sandstone at Upheaval Dome. This work will evaluate the validity these cataclastic dikes as an additional line of evidence that supports an impact event at Upheaval Dome.

**Findings/Accomplishments for 2007:** The field area was scouted during March 5-6, 2007. No further activity was conducted this report year due to the PI's scheduling constraints.

**4) Study Title:** Aquatic macroinvertebrate survey of Stillwater Canyon

**Permit No.:** CANY-2007-SCI-0004

**Principal Investigator:** Joseph Kotynek

**Purpose of Scientific Study:** The purpose of the study is to compile an aquatic macroinvertebrate species list of Stillwater Canyon. We would like to catalog the current biodiversity of aquatic insects, especially potential rare species of Mayflies (Ephemeroptera) and other uncommon Southwest taxa.

**Findings/Accomplishments for 2007:** No activity was conducted this report year, and this project has been suspended.

**5) Study Title:** Chronostratigraphy of alluvium in Horseshoe Canyon:

Paleoenvironments and indirect dating of Barrier Canyon rock art

**Permit No.:** CANY-2007-SCI-0005

**Principal Investigator:** Joel Pederson

**Purpose of Scientific Study:** This proposed research has two goals: 1) develop a chronostratigraphy of alluvial deposits along the Horseshoe drainage by field mapping and OSL dating, and 2) bracket the age of Barrier Canyon-style rock art in the study area by documenting and dating its relations to the stratigraphy.

**Findings/Accomplishments for 2007:** A series of three field excursions were undertaken in 2007 to collect basic mapping and stratigraphic data. In addition, a total of 9 sand samples were taken within the park for luminescence dating. Any fieldwork done within the park boundaries that involved sampling were done with the assistance of CNP personnel.

Essentially all raw data has been collected, and the research is currently in the phase of reducing field data, obtaining OSL ages from samples in the laboratory, and preparing a report product for CNP and the funding entity.

Initial results indicate that the alluvial stratigraphy in Horseshoe canyon does not match the simplified model of valley filling and cutting cycles on the Colorado Plateau. Horseshoe Canyon instead has a stratigraphy that varies from reach to reach depending upon bedrock type at wash level and its controls on canyon geometry. Alluvium preserved in the drainage ranges from late Pleistocene through Holocene in age, and initial indications from OSL dating indicate alluvium is generally older than previously hypothesized. The key CNP reach is somewhat unique, but key stratigraphic relations do exist between alluvial packages and Barrier Canyon-style rock art, and both of the project goals can be met as OSL ages are completed and field data are reduced.

**6) Study Title:** Vegetation Data Collection in Support of the U.S. Geological Survey-National Park Service Vegetation Classification and Mapping Program at Canyonlands National Park

**Permit No.:** CANY-2007-SCI-0006

**Principal Investigator:** Janet Coles

**Purpose of Scientific Study:** The National Park Service's Inventory and Monitoring Program, NatureServe, and Engineering-Environmental Management, Inc. (E2M) are collaborating in a multi-year project to produce detailed vegetation maps of the plant communities in Canyonlands National Park.

**Findings/Accomplishments for 2007:** Collection of field data to assess the accuracy of the CANY vegetation map began in 2007. The Island in the Sky District and the Horseshoe Canyon section of the Maze District were completed in 2007. Between 3 and 30 sample points were assigned to each of 31 map classes, based on total area and number of polygons. Sample points were located randomly, using stratification by map class and an algorithm designed to achieve good spatial distribution.

Using keys to plant associations and map classes created for this project, field crew members visited or observed 798 sample points in 2007. Sample points that were inaccessible or dangerous to access were viewed with binoculars from a nearby point; otherwise, data were collected from a 5000 square meter circular plot surrounding the point. Data collected included location information (UTM coordinates, site name), topographic information (slope, aspect, landform), environmental data (substrate, geology), vegetation data (percent cover estimate of dominant or diagnostic vascular plant species), and representativeness (how well the sampled point represented the polygon as a whole). Based on this information, the field worker keyed the site to the best fit for association name and map class. If the vegetation did not key easily, the worker noted this and recorded up to three associations or map classes that best described the vegetation. The accuracy assessment data set will not be analyzed until it is complete. Collection of accuracy assessment data at CANY (Maze, Needles, and River districts) will continue in 2008.

**7) Study Title:** Soil Survey of Canyonlands National Park

**Permit No.:** CANY-2007-SCI-0008

**Principal Investigator:** Victor Parslow

**Purpose of Scientific Study:** To provide an updated soil and ecological site inventory for Canyonlands National Park (CANY), that meets National Cooperative Soil Survey (NCSS) standards and park management and planning needs.

**Findings/Accomplishments for 2007:** 1. Soil inventory activities: Soil survey activities were conducted in Arches National Park in 2007. Traverses and transects of the landscape were conducted, and soil descriptions and plant inventory data recorded, in order to further develop the soil-plant-landscape-geology models which will be essential to the completion of the update of the Soil Survey and Ecological Site Descriptions. 353 soil/landscape observations were documented in FY 2007, and soil samples were collected from 71 of these locations. These samples have been catalogued, and are stored in the Richfield USDA Service Center.

2. Archaeological activities: As a result of the field work of 2007, sixty seven sites and sixteen isolated occurrences were recorded in Canyonlands National Park. Diagnostic artifacts were collected from fifteen locations. Details of these resources, including locations and descriptions, can be referenced in a more complete report, Summary Report of Cultural Resources Support Provided to the Soil Surveys of Natural Bridges National Monument, Arches National Park, Canyonlands National Park and Hovenweep National Monument For the Year 2007, at the SEUG office in Moab, Utah. All cultural resources were successfully avoided. No cultural material was unearthed during the course of soil sample collection.

**8) Study Title:** Impacts of Climatic Change and Land Use on the Southwestern U.S.

**Permit No.:** CANY-2007-SCI-0009

**Principal Investigator:** Jayne Belnap

**Purpose of Scientific Study:** General Project Goals:

- Understand how past climatic change affected land surface: soil loss, fluvial erosion and alluviation, sand-dune mobilization, ecosystems, under time frames of past decades, centuries, and millennia.
- Understand today's interplay among climate, land use and surface processes (geologic and ecologic).
- Understand the impacts of future climate on land surface under the following time frames: seasons; El Niño/La Niña cycles; multi-year wet/drought periods; and

decades, as atmospheric CO<sub>2</sub> increases.

A major goal is to interact with federal, state, and local government agencies as well as non-governmental organizations to provide information useful for management decisions regarding land-surface vulnerability to wind erosion. Another goal is to provide to managers and other parties ongoing remote sensing and meteorological monitoring bearing on the vulnerability of the land to natural and human disturbances.

Specific goals for Canyonlands work

- Understand geologic origins of soil nutrients and the interactions of soil compounds and plants.

- Understand geomorphic controls on plant distribution

- Understand the recent (past several decades, centuries, millennia)

geologic/geomorphic evolution of the ecosystem to reveal patterns of surface stability and instability.

- Recognize areas vulnerable to wind erosion and soil loss.

- Understand conditions of cheatgrass (and other exotic plants) invasion to predict areas most vulnerable to expansion and to help devise mitigation strategies.

**Findings/Accomplishments for 2007:** This is an ongoing study and although data are still being collected, no synthesis has been created yet. All data, repeat photography, and collection methods are available to the public at [http://esp.cr.usgs.gov/info/sw/clim-met/U.S. Geological Survey, MS-980 Federal Center, Box 25046, Denver, CO 80225](http://esp.cr.usgs.gov/info/sw/clim-met/U.S.%20Geological%20Survey,%20MS-980%20Federal%20Center,%20Box%2025046,%20Denver,%20CO%2080225).

**9) Study Title:** The Role of Biological Soil Crusts in soil nutrient cycles as Influenced by Soil Surface Disturbance, Climate Change and Annual Grass Invasion

**Permit No.: CANY-2007-SCI-0010**

**Principal Investigator:** Jayne Belnap

**Purpose of Scientific Study:** This project will establish how alterations in species composition by surface disturbance, invasive grasses, and/or climate change may affect N and C inputs and fluxes, in different soils under different climatic regimes.

**Findings/Accomplishments for 2007:** This is a long-term project that is maintained, and data are collected twice annually. This is a particularly rich study, and publications are produced regularly. In 2007, the following papers were published that utilized data from this research:

- 1) Belnap, J., S. L. Phillips, S. Flint, J. Moeny and M. Caldwell (2008). Global change and biological soil crusts: Effects of ultraviolet augmentation under altered precipitation regimes and nitrogen additions. *Global Change Biology*.

- 2) Belnap, J., S. L. Phillips, D. L. Witwicki and M. E. Miller (2008). Visually assessing the level of development and soil surface stability of cyanobacterially dominated biological soil crusts. *Journal of Arid Environments*.

- 3) Belnap, J. and S. K. Sherrod (2008). Salt sensitivity of the exotic grass *Bromus tectorum* L. and facilitation by *Hilaria jamesii* (Torr.) Benth. *Plant Ecology*.

- 4) Bowker, M. A. and J. Belnap (2008). A simple classification of biological soil crust habitat on the Colorado Plateau, USA. *Journal of Vegetation Science*.

- 5) Schwinning, S., J. Belnap, D. R. Bowling and J. R. Ehleringer (2008). Sensitivity of the Colorado Plateau to change: Climate, ecosystems and society. *Ecology and Society*.

- 6) Housman, D. C., C. M. Yeager, B. J. Darby, J. Sanford, Robert L., C. Kuske, D. A. Neher and J. Belnap (2007). Heterogeneity of soil nutrients and subsurface biota in a dryland ecosystem. *Soil Biology and Biochemistry* 39: 2138-2149.

- 7) Newingham, B. A., P. Vidiella and J. Belnap (2007). Do soil characteristics or microhabitat determine field emergence and success of *Bromus tectorum*? *Journal of Arid Environments* 70(3): 389-402.

8) Yeager, C. M., J. L. Kornosky, R. Morgan, E. Cain, J. Belnap and C. R. Kuske (2007). Three distinct clades of cultured heterocystous cyanobacteria comprise the dominant N<sub>2</sub>-fixing members of biological soil crusts of the Colorado Plateau, USA. *FEMS Microbiology Ecology* 60(1): 85-97.

**10) Study Title:** Riparian and Aquatic Invertebrate Monitoring Protocol and Development (NPS I&M Program)

**Permit No.:** CANY-2007-SCI-0011

**Principal Investigator:** Anne Brasher

**Purpose of Scientific Study:** The objective of the study is to develop a rigorous, well-integrated set of protocols for long-term macroinvertebrate monitoring across the Colorado Plateau. Another objective is to evaluate the utility of aquatic macroinvertebrates as reliable indicators of aquatic ecosystem conditions in dryland systems characteristic of the Colorado Plateau.

**Findings/Accomplishments for 2007:** Pilot studies assessing habitat characterization and evaluating benthic macroinvertebrate collection techniques were not conducted in Salt Creek in 2007. The National Park Service Inventory and Monitoring Program of the Northern and Southern Colorado Plateau Aquatic Macroinvertebrate Monitoring Protocol and Development project is complete. A report titled "Pilot protocol implementation; report on macroinvertebrate communities and habitat characteristics in National Parks of the Colorado Plateau" is in press as a National Park Service Technical Report and will be distributed upon publication. In addition to the main report, we will be providing a brief summary of habitat characterization and macroinvertebrate data that was collected in Salt Creek throughout the study to the Chief Resource Manager of Canyonlands by March 30, 2008.

**11) Study Title:** Abundance Estimates for Colorado pikeminnow in the Green River Basin, Utah and Colorado.

**Permit No.:** CANY-2007-SCI-0012

**Principal Investigator:** Patrick Goddard

**Purpose of Scientific Study:** Obtain an accurate (unbiased) and reliable (precise) estimate of the adult population abundance and survival of Colorado pikeminnow that occupy the Green River study area. The Green River Study area includes The Yampa, White, Duchesne and entire Green River from Flaming Gorge down stream to the confluence with the Colorado River. Basin wide estimates of population size, survival rates, distribution and movement are completed and reported every 3 years. Estimates are based on 3 pass mark recapture trips completed in the spring typically before the spring peak in flows, which marks the beginning of spawning migrations for the Colorado pikeminnow.

**Findings/Accomplishments for 2007:** Three electrofishing passes were completed during late May through June. All endangered fish captured were PIT tagged, physical data collected, and returned to their location of capture. In total 341 Colorado pikeminnow were captured marked and returned to the river. All data management, analysis, and reporting is overseen by Kevin Bestgen with the Larval Fish Laboratory at Colorado State University.

Within the stretch of the Green River between the Colorado River confluence and the Green River State Park (120 miles) the following endangered fish were encountered, marked, and released:

Colorado pikeminnow: 341, ranging from 83 to 720 mm. long

Bonytail chub: 17, ranging from 121 to 467 mm. long

Razorback suckers: 217, ranging from 219 to 520 mm. long

Other native fish encountered included:

Roundtail chub  
Flannelmouth sucker  
Bluehead sucker  
Speckled dace

Nonnative species encountered included:

Gizzard Shad  
Grass carp  
Walleye  
Green sunfish  
Black Crappie  
Black and Yellow bullheads  
channel catfish  
common carp  
sand shiners  
red shiners  
fathead minnows

**12) Study Title:** Reconstructing the geometry and palaeoclimate of the Cedar Mesa and White Rim Sandstone (Permian)

**Permit No.:** CANY-2007-SCI-0013

**Principal Investigator:** Nigel Mountney

**Purpose of Scientific Study:** This field-based research project aims to examine and document the sedimentology and paleoenvironment of a succession of Permian-age, arid-climate continental successions exposed within the Paradox Basin of the Canyonlands District, SE Utah. Field-based data is being used to develop and constrain quantitative predictive models for eolian and desert-margin evolution within ancient arid sedimentary systems. This is being achieved through an ongoing outcrop study of mixed fluvial, aeolian and lacustrine strata within the Permian Lower Cutler Beds, Cedar Mesa Sandstone, Organ Rock Formation and White Rim Sandstone, which together form the bulk of the Cutler Group in SE Utah. The project is helping to determine the response of desert margin deposits to cyclical changes in climate.

**Findings/Accomplishments for 2007:** Research in 2007 has focussed on erecting a stratigraphic framework for the Organ Rock Formation which conformably overlies the Cedar Mesa Sandstone across much of the Canyonlands region of SE Utah. The 100 m-thick Organ Rock succession represents the deposits of a terminal fluvial fan system which exhibited significant downstream transmission losses such that stream systems terminated before reaching a significant standing water body. The distal parts of the fluvial fan interfingered with a series of eolian dune-fields that occupied the region in what is now southern-most Utah. Eighty three sedimentary logs and 20 architectural panels document the detailed sedimentology of the succession.

**13) Study Title:** Intermountain West Native Plant Pollination Project

**Permit No.:** CANY-2007-SCI-0014

**Principal Investigator:** James Cane

**Purpose of Scientific Study:** Native bees and/or honey bees are needed to pollinate most of the wildflower species considered for Great Basin rehabilitation. The pollinator faunas of many candidate plant genera include one or more bee genera with potentially manageable species. After pollinator needs are evaluated by

comparing fruit and seed sets at caged flowers and openly visited flowers we can assess whether plant reproduction is pollinator limited. If plant reproduction proves to be pollinator limited, then native bee faunas need to be surveyed and evaluated at managed and wild flowering populations. One of the candidate flower genera that we have been working with as a potential for seed production is *Sphaeralcea* spp. Based on data we collected from our 2006 experimentation, we have determined that these plants require a pollinator for successful reproduction. The primary purpose of our data collection, within the parks, is to investigate and quantify the pollinators that are associated with *Sphaeralcea* spp. This information will be used to identify bees that are important pollinators of these species and whether the pollinators are potential candidates for management. We hope to develop sustainably managed pollinators that can be used on farms which will grow native *Sphaeralcea* spp. for BLM restoration purposes.

**Findings/Accomplishments for 2007:** To identify species of bees that currently pollinate *Sphaeralcea grossularifolia* we collected and characterized a small sample of associated pollinator fauna collected at two locations within Canyonlands National Park. A standardized sampling protocol was used. Briefly, thirty plants within a stand were counted and systematically sampled collecting all bee fauna visiting each plant. When bees were not present on a plant, the plant was counted in the total sample to estimate bee abundance. The actual number of plants that bees were collected on was also recorded. At site one (Spanish bottom), sixteen bees were collected on 15 plants (38.9.475lat / 109.56.55 long) and 18 bees were collected on 10 plants at site two (Doll house) (38.9.435 lat / 109.56.828 long). One plant voucher specimen was taken at each location and each has been verified as *S. grossularifolia*. Bee samples have been mounted, labeled, and entered into a specimen-level database at the United States National Pollinating Insect Collection at the USDA-ARS Pollination Insect Biology, Management and Systematics Laboratory facilities in Logan UT. Identifications to genera are completed and provided below. At this time, based on genera level identification, none of the collected specimens are potential manageable pollinators due to nesting constraints unless *Sphaeralcea grossularifolia* seed farmers are adjacent to locations where these ground nesting bees occur naturally.

Accession-number	ID-Number	Family	Genera	Nesting
CANY-605	CANY-45943	Andrenidae	Calliopsis	Solitary ground
CANY-605	CANY-45944	Apidae	Diadasia	Gregarious ground
CANY-605	CANY-45945	Mellitidae	Hesperapis	Gregarious ground
CANY-605	CANY-45946	Mellitidae	Hesperapis	Gregarious ground
CANY-605	CANY-45947	Mellitidae	Hesperapis	Gregarious ground
CANY-605	CANY-45948	Mellitidae	Hesperapis	Gregarious ground
CANY-605	CANY-45949	Mellitidae	Hesperapis	Gregarious ground
CANY-605	CANY-45950	Andrenidae	Perdita	Communal ground
CANY-605	CANY-45951	Andrenidae	Perdita	Communal ground
CANY-605	CANY-45952	Andrenidae	Perdita	Communal ground
CANY-605	CANY-45953	Andrenidae	Perdita	Communal ground
CANY-605	CANY-45954	Andrenidae	Perdita	Communal ground
CANY-605	CANY-45955	Andrenidae	Perdita	Communal ground
CANY-605	CANY-45956	Andrenidae	Perdita	Communal ground
CANY-605	CANY-45957	Sphecidae	Pulverro	
CANY-605	CANY-45976	Diptera		
CANY-605	CANY-45958	Mellitidae	Hesperapis	Gregarious ground
CANY-605	CANY-45959	Mellitidae	Hesperapis	Gregarious ground
CANY-605	CANY-45960	Mellitidae	Hesperapis	Gregarious ground



CANY-605 CANY-45961 Mellitidae Hesperapis Gregarious ground  
CANY-605 CANY-45962 Mellitidae Hesperapis Gregarious ground  
CANY-605 CANY-45963 Mellitidae Hesperapis Gregarious ground  
CANY-605 CANY-45964 Mellitidae Hesperapis Gregarious ground  
CANY-605 CANY-45965 Mellitidae Hesperapis Gregarious ground

**14) Study Title:** Amphibian population dynamics and invertebrate diversity of Salt Creek Canyon, Canyonlands National Park: differences correlated with presence/absence of 4WD vehicle use

**Permit No.: CANY-2007-SCI-0016**

**Principal Investigator:** Tim Graham

**Purpose of Scientific Study:** The objectives of this study are to: 1) establish riparian and aquatic invertebrate and amphibian monitoring locations in the vicinity of vegetation monitoring stations; 2) evaluate a variety of sampling methods for invertebrates and amphibians to determine which provides the best estimates of community structure (relative abundance and species composition); 3) identify which taxa, guilds, functional groups of invertebrates and/or amphibians will make optimum indicators of riparian and aquatic ecosystem recovery in Salt Creek; 4) recommend the best monitoring techniques for target indicator groups based on results of this research; 5) work with CANY staff to develop, test and refine a monitoring plan that will guide sampling, analysis, and interpretation of the data collected over time, and that can be extended to other parts of CANY as well as other units of SEUG.

**Findings/Accomplishments for 2007:** We conducted sampling at four sites in June 2007. All samples from RO3, CL1, CL10, and NR2 collected in June and September from 2000 to 2007 have been sorted to order, and these data have been entered into computer files. The Heteroptera from these samples have been identified to family, and the ants to genus. Analysis, further identifications, and interpretation of data are planned for 2008.

**15) Study Title:** Interactions of climate change and other environmental factors on invasive plant infestation in the arid west

**Permit No.: CANY-2007-SCI-0017**

**Principal Investigator:** Jayne Belnap

**Purpose of Scientific Study:** Introduced Mediterranean annual grasses currently comprise 50-85% of vascular plant cover in over two-thirds of the West. One of these species, *Bromus tectorum*, alone dominates over 100 million acres the Intermountain West, with an additional 62 million at high risk from invasion (EPA-EMAP, unpublished; Whisenant 1990). On-going conversion of native vascular plant communities to annual grasses is a threat to the population viability of many native plant and animal species, through direct plant replacement or changes in habitat characteristics, such as timing and quantity of food and cover and altered nutrient cycles.

It has long been thought that surface disturbance is a necessary prerequisite for annual grass invasions into established perennial plant communities. However, annual grasses have been seen to invade undisturbed ecosystems as well. In addition, annual grass invasions are often patchy, with some soils apparently uninvasable. In addition, grazing can often convert areas to annual grasses, while nearby areas with similar grazing are not converted. Agronomists have long known that one of the most important soil characteristics affecting plants is the availability of soil nutrients. The relative levels of specific soil nutrients, rather than disturbance, successfully explained site-specific patterns of *Bromus* invasion in SE Utah grasslands. This project will determine if invasion susceptibility of grassland

ecosystems in SE Utah can be predicted by variations in soil characteristics attributable to geomorphic and pedogenic processes within a given watershed. We will do this by comparing soils in Gray's Pasture (once heavily grazed, not invaded) with soils at Squaw Flat (once heavily grazed, now heavily invaded). We have already sampled the soils at Squaw Flat. We now need to collect soil from Gray's Pasture. This will entail augering 5 holes, 4" in diameter and up to 72" deep. These samples will be consumed in analysis. This project is funded by USGS, and will cost approximately 5K.

With many millions of acres currently dominated by non-indigenous annual grasses, and 62 million acres of rangeland habitat highly susceptible to conversion, annual grasses are emerging as a major factor to be considered as we contemplate the future of rangeland ecosystems. It is critical that we understand whether managers can stop or buffer these invasions, and/or restore habitats after conversion. Determining factors that precipitate or facilitate invasion may provide management tools for preventing dominance of aliens in areas where the population viability of species is of concern, and facilitate re-establishment of lost habitat. In addition, understanding how annual grass invasion changes natural ecosystem processes, such as nutrient availability, water availability, and soil microbial systems and how these changes affect re-establishment of native perennial plants, will enhance efforts to restore lost habitat.

**Findings/Accomplishments for 2007:** Data for this study was collected late in 2007, so all samples and data are still awaiting analysis.

**16) Study Title:** Sound Levels in Canyonlands National Park.

**Permit No.:** CANY-2007-SCI-0018

**Principal Investigator:** Skip Ambrose

**Purpose of Scientific Study:** To determine natural ambient sound levels in the primary vegetation types in CANY, and the relative influence of human-caused sounds on natural sound levels.

**Findings/Accomplishments for 2007:** Acoustic data were collected in CANY in 2007 at one location (Green River, Upheaval Bottom area). 2007 was the final year of data collection for the acoustic study. Data are currently being analyzed and a report is being prepared.

**17) Study Title:** Earthscope/US Array Transportable Array Seismic Station

**Permit No.:** CANY-2007-SCI-0031

**Principal Investigator:** Robert Busby

**Purpose of Scientific Study:** The EarthScope USArray Transportable Array is an Earthquake monitoring system, operated and maintained by IRIS, (a non-profit corporation of US Universities) on behalf of the National Science Foundation as part of the EarthScope Major Research Equipment Facility Construction. It uses continuously operating seismic stations to measure ground motion caused by earthquakes and volcanic processes. The purpose of the study is to generate a three dimensional map of earth structure beneath the North American Continent. Additional information at [www.earthscope.org](http://www.earthscope.org) and the 200 page project proposal at: [http://www.earthscope.org/links\\_pubs/documents/es\\_parts\\_I-IV\\_lo\\_1.25.pdf](http://www.earthscope.org/links_pubs/documents/es_parts_I-IV_lo_1.25.pdf)

**Findings/Accomplishments for 2007:** 439 regional earthquakes and 950 distant earthquakes were recorded since the station was installed on 6/16/2007. (A report showing the distribution of events recorded so far will be attached)

